Dr Naveen Kalra , MD, MAMS, FICR

Additional Professor

Department of Radiodiagnosis & Imaging, PGIMER, Chandigarh, India

Area of Interest : Hepatobiliary & GIT imaging and interventions

Publications : 95

Chapters : 17

Paper presentations : 69

Guest lectures : 68

Other achievements

- UICC ICRETT Fellowship at the Johns Hopkins Hospital, USA
- RSNA Derek Harwood-Nash International Fellowship in Interventional Radiology
- Prof. V.P. Lakhanpal Gold Medal and Oncoimaging award by the ICRI
- Short term observerships at
  - Massachusetts General Hospital, Harvard Medical School, Boston, USA
  - Toronto General Hospital, Toronto, Canada

Radiology in IBD: Current Role: When and What

Naveen Kalra

Additional Professor

Department of Radiodiagnosis

PGIMER,Chandigarh

Introduction

- Crohn disease (CD) and ulcerative colitis (UC)
- Relapsing and remitting course
- CD- Affects any part of GIT from mouth to anus, small bowel (30-40%), ileocolonic (40-55%), colon (15-25%)
- UC- Affects the colon

Introduction

- No single test allows unequivocal diagnosis
- Imaging features provide supportive evidence
- Aim of imaging is to detect and assess subtype, location and severity of disease
- To predict disease activity

Imaging Modalities

- Plain X-ray abdomen
- Small bowel follow through/ small bowel enteroclysis/ barium enema
- Ultrasound (abdomen/endorectal)
- CT enterography/enteroclysis/ colonoscopy
- MR enterography/enteroclysis/ colonoscopy
- Scintigraphy: labeled leucocyte scintigraphy, PET/CT, PET/CT with FDG labeled leucocytes

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Abdom Imaging. 2004 May-Jun;29(3):335-40.

Small bowel tuberculosis: enteroclysis findings.

Nagi B[1], Sodhi KS, Kochhar R, Bhasin DK, Singh K.

Author information

Abstract

We describe the radiologic appearances of small bowel tuberculosis as shown by enteroclysis. A total of 265 patients with proven small bowel tuberculosis seen over a period of more than one decade was evaluated. All patients had positive radiologic findings as shown on enteroclysis examination. Of the 265 patients with small bowel tuberculosis, 174 had isolated small bowel involvement with a normal ileocecal region, whereas 91 had associated noncontiguous involvement of the ileocecal region. The most common radiologic finding was the presence of strictures, noted in 62.7% of cases. Most strictures were short, concentric, and smooth in outline. These strictures were solitary or multiple and located mainly in the jejunum. Other radiologic findings were adhesions (21.8%), ulcerations (9.1%), and diffuse thickening of folds (6.4%). Complications noted were in the form of enteroliths, perforations, and fistulae. The radiographic findings of small bowel tuberculosis, although non-specific, may indicate tuberculosis in a high-risk population.

2004-2006

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Abdom Imaging. 2006 Jul-Aug;31(4):417-24. Epub 2006 Jan 30.

Sonoenteroclysis: a new technique for the diagnosis of small bowel diseases.

Nagi B[1], Rana SS, Kochhar R, Bhasin DK.

Author information

Abstract

BACKGROUND: Radiologic evaluation of small bowel is usually done by barium examination, which involves considerable radiation exposure. A new sonographic method, sonoenteroclysis, is a promising technique for diagnosing small intestinal disorders. In this study the applicability, performance, and diagnostic yield of sonoenteroclysis were assessed and the results of this novel method were compared with those of barium enteroclysis.

METHODS: Forty-five consecutive patients with suspected small bowel disorder were studied. All patients underwent abdominal ultrasound before and after infusion of an isotonic nonabsorbable electrolyte solution containing polyethylene glycol through a nasojejunal tube (modified Billbao Dotter tube), and images at various levels were obtained. Small bowel wall thickness, luminal narrowing, intestinal dilatation, peristalsis, and extraintestinal complications were noted. It was followed by barium enteroclysis and findings were recorded. Findings of sonoenteroclysis were compared with those of barium enteroclysis.

Indian J Gastroenterol. 2006 Sep-Oct;25(5):230-32.

Comparison of multidetector computed tomographic colonography and conventional colonoscopy for detection of colorectal polyps and cancer.

Kalra N[1], Suri S, Bhasin DK, Sinha SK, Saravanan N, Kour T, Vaiphei K, Wig JD.

Author information

Abstract

BACKGROUND: Computed tomographic colonography (CTC) is a new technique for detecting colonic neoplasms. Data on the utility of this method in the Indian population are limited.

METHODS: Forty-two patients with symptoms of colonic disease underwent CTC and conventional colonoscopy (CC) within one week of each other and the findings at these two investigations were compared.

RESULTS: The entire colon could be evaluated in 38 patients on CTC and in 23 patients on CC. Of the 19 patients who had incomplete CC, 14 had occlusive colonic lesions. Of the 86 lesions detected on CC, 76 (88.4%) were correctly identified on CTC with regard to location and size. CTC was false negative for 10 lesions and false positive for 5 lesions in 3 patients. The sensitivity and specificity of CTC were 65% and 77%, respectively, for lesions 1-5 mm; 97% and 83% for 6-9 mm-sized lesions; and 100% and 100% for lesions 10 mm or larger. Extracolonic findings were seen in 24 of 42 patients (57%).

CONCLUSIONS: CTC is reliable for detecting lesions 6 mm or larger in size. It permits evaluation of the region proximal to an occlusive growth, which is often not possible with CC.

2006-2009

Display Settings: Abstract

J Gastroenterol Hepatol. 2009 Jul;24(7):1307. doi: 10.1111/j.1440-1746.2009.05958.x.

Education and imaging. Gastrointestinal: virtual CT ileoscopy in terminal ileitis.

Kalra N[1], Rana S, Bhasin DK, Khandelwal N.

Eur J Radiol. 2012 Mar;81(3):406-10. doi: 10.1016/j.ejrad.2010.12.001. Epub 2011 Jan 15.

Comparison of neutral and positive enteral contrast media for MDCT enteroclysis.

Aiyappan SK[1], Kalra N, Sandhu MS, Kochhar R, Wig JD, Khandelwal N.

⊕ Author information

Abstract

OBJECTIVE: To compare neutral and positive enteral contrast media for MDCT enteroclysis (MDCTE) in various small bowel diseases.

MATERIALS AND METHODS: 40 patients with suspicion of small bowel diseases were divided randomly into two equal groups. In one group, water was used as neutral enteral contrast and in other group, 2% water soluble iodinated contrast was used as positive enteral contrast. All MDCTE were done on a 16-slice multidetector row CT unit. The findings of MDCTE were compared with the standards of reference.

RESULTS: There were 12 cases of abdominal tuberculosis (30%), 5 cases of bowel mass (12%), 4 cases of Crohn's disease (10%), 3 cases of

Clin Radiol. 2014 Mar;69(3):315-22. doi: 10.1016/j.crad.2013.10.009. Epub 2013 Nov 26.

Spectrum of imaging findings on MDCT enterography in patients with small bowel tuberculosis.

Kalra N[1], Agrawal P[2], Mittal V[2], Kochhar R[3], Gupta V[4], Nada R[5], Singh R[4], Khandelwal N[2].

⊕ Author information

Abstract

Abdominal tuberculosis (TB) is the sixth most common extrapulmonary site of involvement. The sites of involvement in abdominal tuberculosis, in descending order of frequency, are lymph nodes, genitourinary tract, peritoneal cavity, and gastrointestinal tract. The radiological armamentarium for evaluating tuberculosis of the small bowel (SBTB) includes barium studies (small bowel follow-through, SBFT), CT (multidetector CT, CT

Imaging modalities

Small bowel follow through (SBFT)

- 'Traditionally' the primary imaging method of choice
- 600 ml of 66% w/v of barium suspension in water administered per orally, passage of barium is tracked with half hourly spot films
- Disadvantages: Passive transit study of barium, poor luminal distensibility and overlap of bowel loops, no extraluminal information
- No information about disease activity

Imaging modalities (contd.)

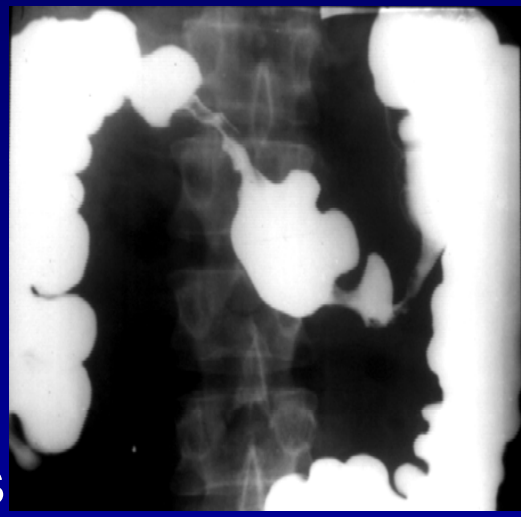
Barium enteroclysis

- Involves catheter intubation and luminal distension
- Mucosal details, ulcers, strictures and fistulae are better demonstrated
- Disadvantages: Invasiveness, extended exam. time, high radiation dose
- No information about disease activity
- Accuracy of SBFT is 89-97% vs 83-100% for enteroclysis

Imaging modalities (contd.)

Barium enema

- Single contrast barium enema has a markedly inferior performance profile versus double contrast barium enema
- SCBE-82-95% sensitivity for Colon Ca
- DCBE- 80-100% sensitivity for Colon Ca
- Diagnostic yield- 5.1% for neoplastic lesions and 6.2% for advanced neoplastic lesions, lower than screening colonoscopy



Imaging modalities (contd.)

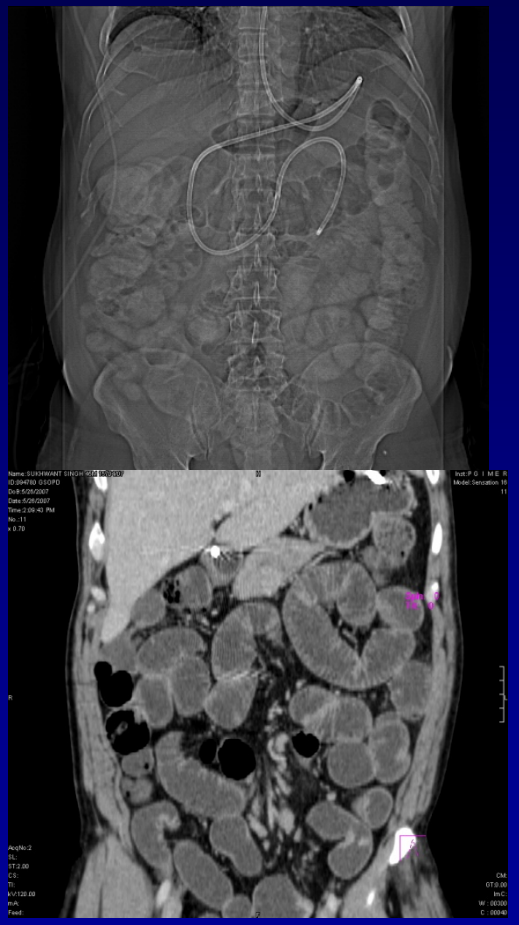
Conventional CT

- Evaluates bowel wall and extraintestinal pathology
- Bowel wall thickening, regional lymph nodes and vascularity
- Disadvantage: Poor distension of bowel loops in many patients

Imaging modalities (contd.)

CT enteroclysis

- Hybrid method that combines the advantage of enteral volume challenge of enteroclysis and ability of cross-sectional imaging of CT
- Provides luminal, mural, extramural information
- Disadvantages:Invasiveness, extended exam. time, high radiation dose



Imaging modalities (contd.)

CT enterography

- Enteral volume challenge with neutral contrast is given orally in a controlled way without nasojejunal intubation
- Disease activity, greater patient acceptance
- Fast acquisition of volume data, high resolution multiplanar reformation can be done in all planes

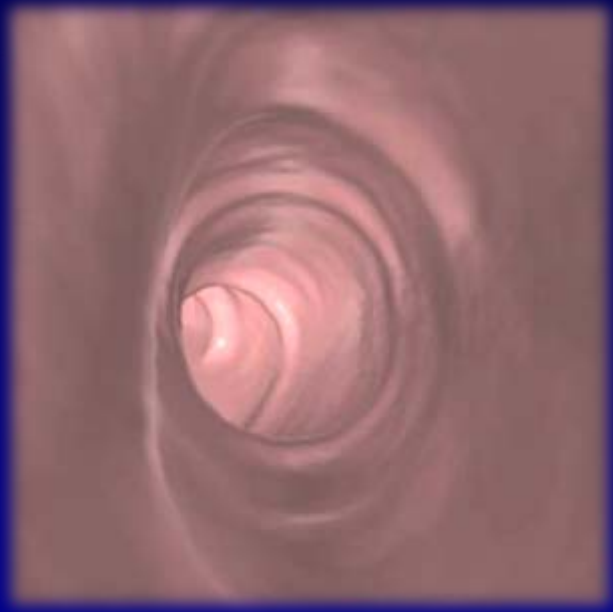
Imaging modalities (contd.)

MR enterography

- Enteral volume challenge with neutral contrast is given orally without nasojejunal intubation
- Active inflammation: Bowel wall thickening, high T2 mural signal, mural hyperenhancement with stratification and hyperemic vasa recta
- No ionizing radiation, multiple serial examinations
- Disadvantages: availability, cost, long exam. time

Imaging modalities (contd.)

CT colonoscopy



- Volumetric data obtained by high resolution helical CT is analyzed using specialized computer software to generate endoluminal images
- Clean and distended bowel, volume CT, post-processing

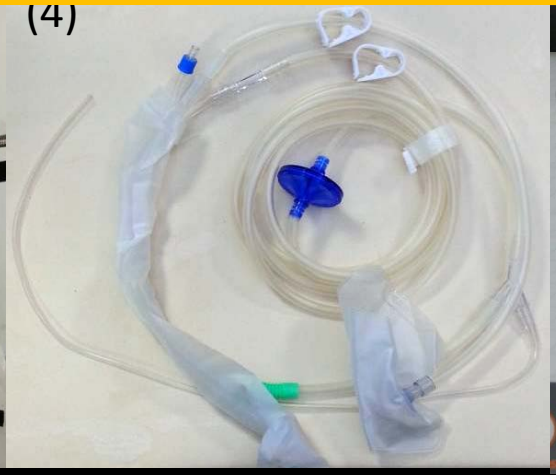
Improvement in CTC

(1)

(2)

(3)

(4)



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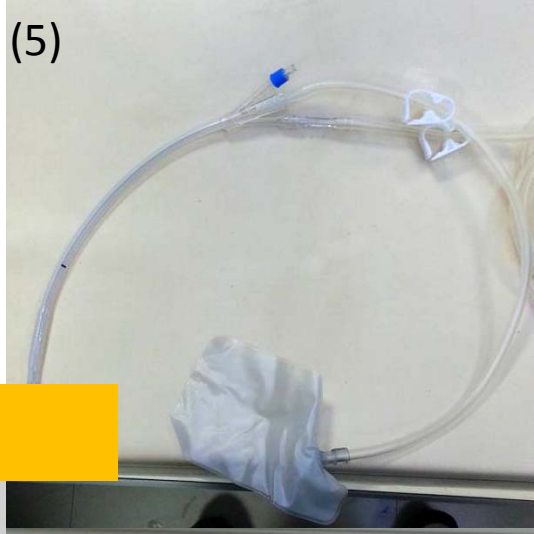

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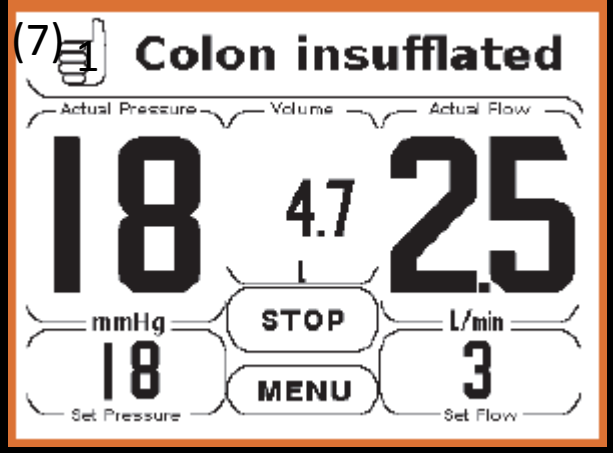


Automated carbon dioxide insufflation device (1,2) with CO_2 cylinders attached at back (3). Also shown is the 3 way Foley catheter with 50 cc balloon, large bag for effluents (4, 5) with "Y" connector for external release of overpressure and their attachment to the system (6). The system shows the set pressure, set flow, the current colonic pressure, flow rate and also indicates when adequate colonic insufflation is achieved (7)

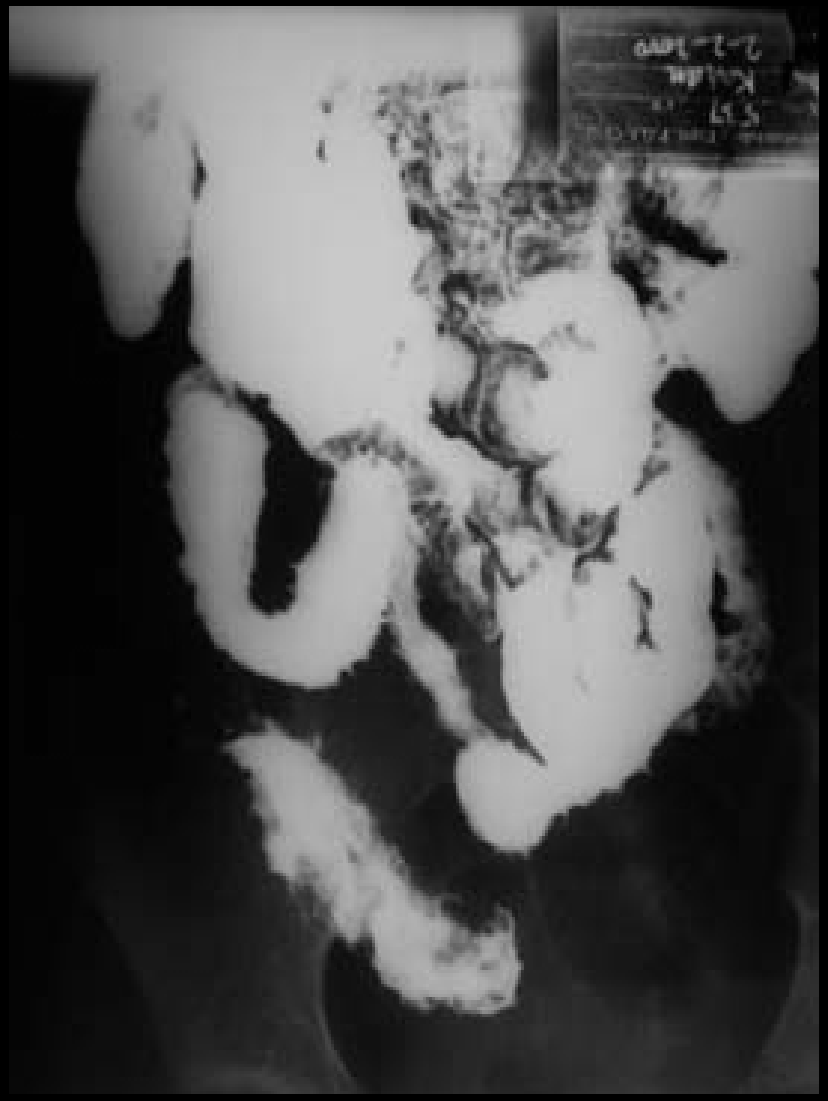
CD vs UC

Radiological findings	CD	UC
Site	Mouth to anus	Colon
Extent	Skip lesions	Diffuse
Small bowel involvement	Common	Backwash ileitis
Barium Exam.		
Mucosal pattern	Smooth	Granular
Polyps	Infrequent	Frequent
Cobblestoning	Frequent	Infrequent
Fistulae	Common	Rare
Malignant change	Low risk	High risk

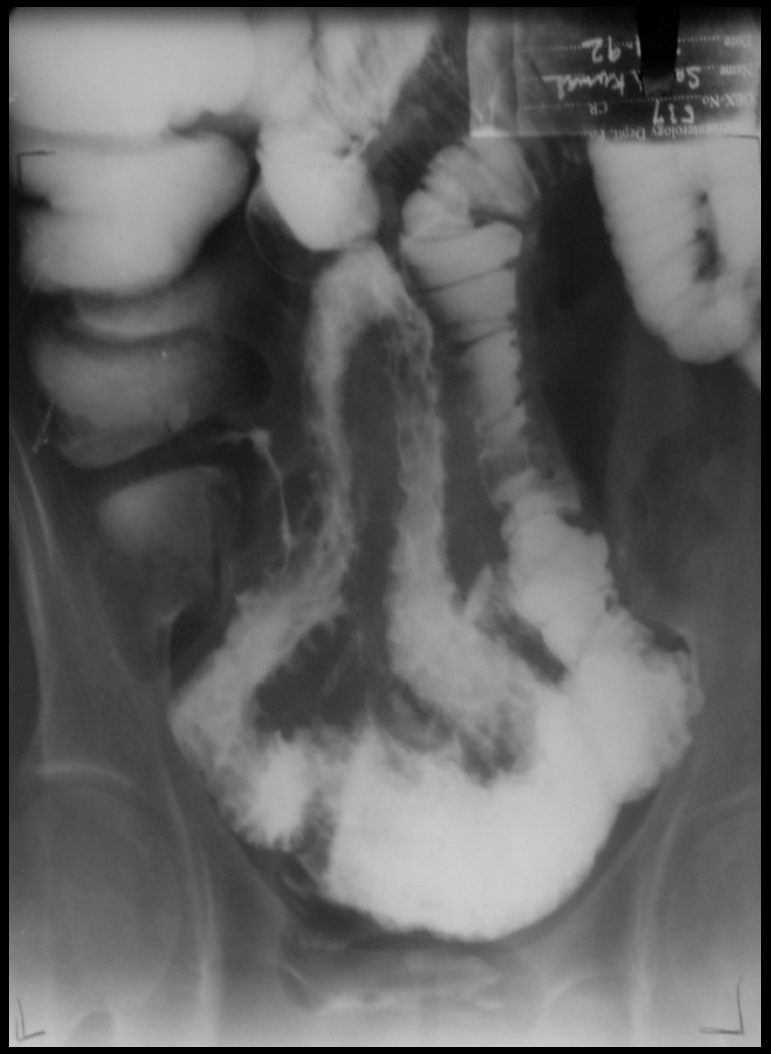
CD vs UC, contd.

Radiological findings	CD	UC
CT/MRI		
Mural stratification	Present (acute phase) Absent (chronic phase)	Present
Wall thickness	Marked	Moderate
Wall enhancement	Homogeneous (chronic phase)	Inhomogeneous
Mesenteric involvement	Fibrofatty proliferation	Not seen

Crohn Disease

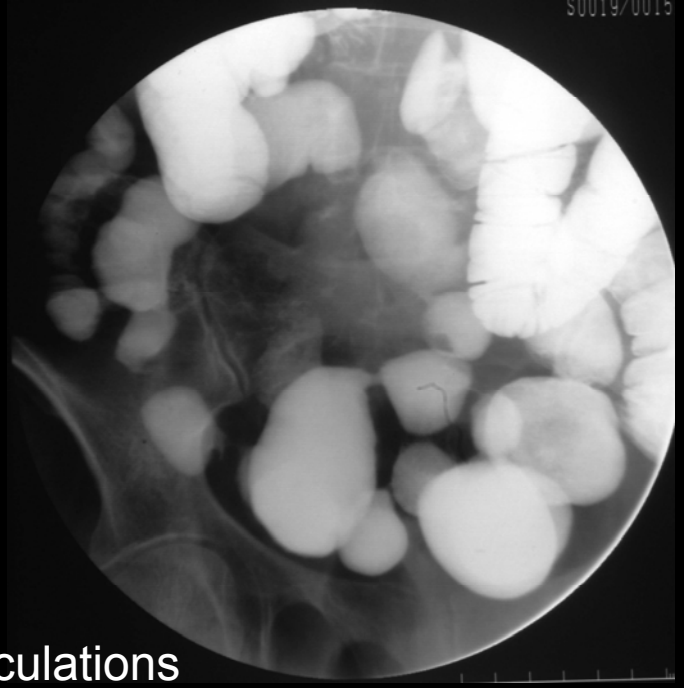


SBFT- Fissuring ulcers

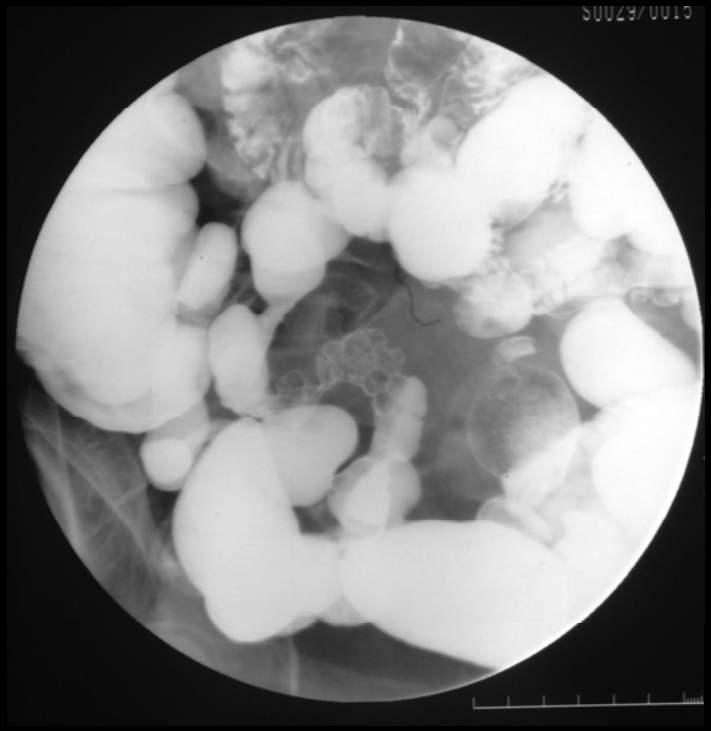


Barium enteroclysis-Cobblestone appearance, deep transverse and longitudinal ulcers separated by residual areas of edematous mucosa

SBFT-Eccentric strictures with pseudosacculations

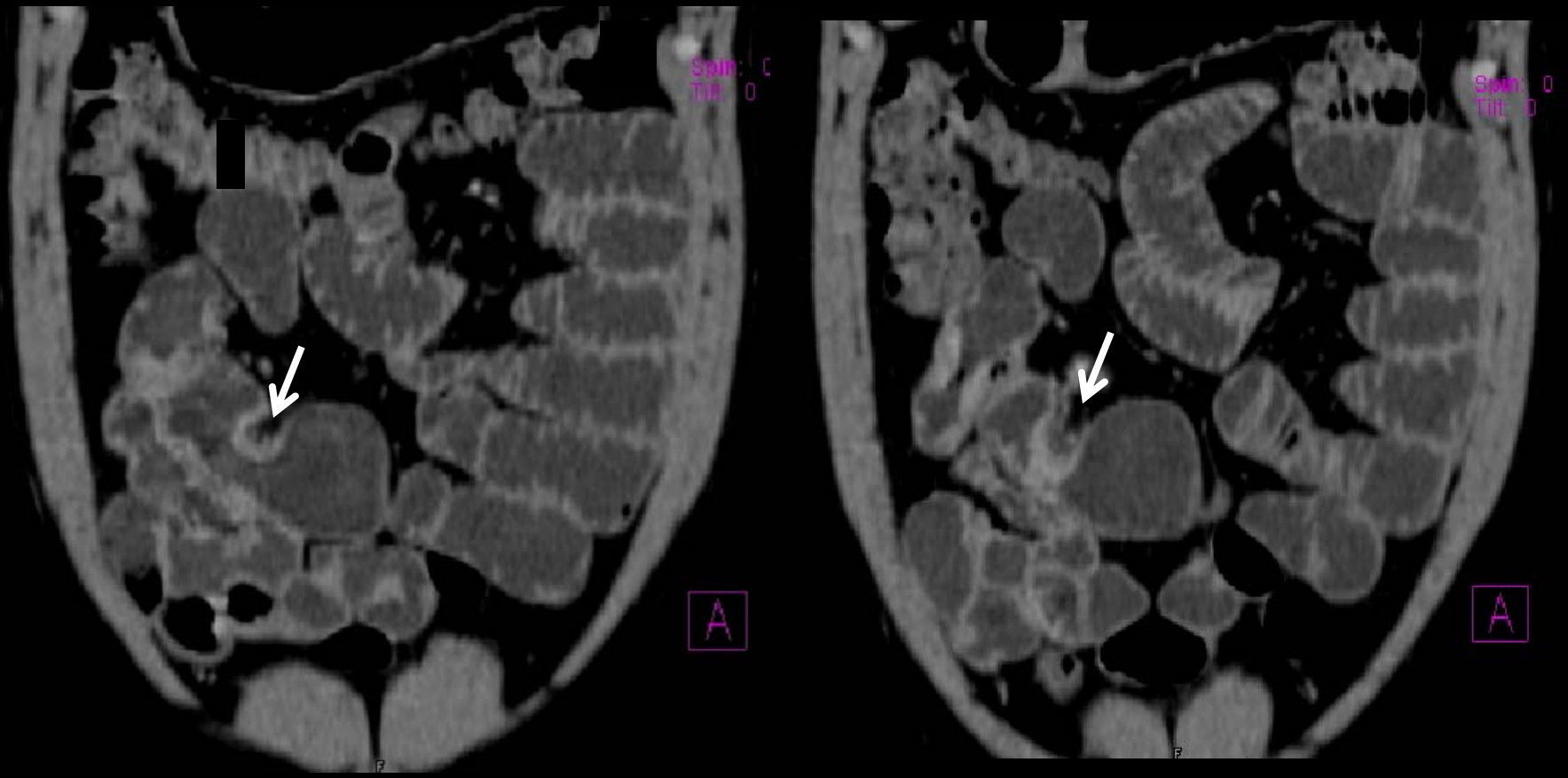


Eccentric strictures with pseudosacculations



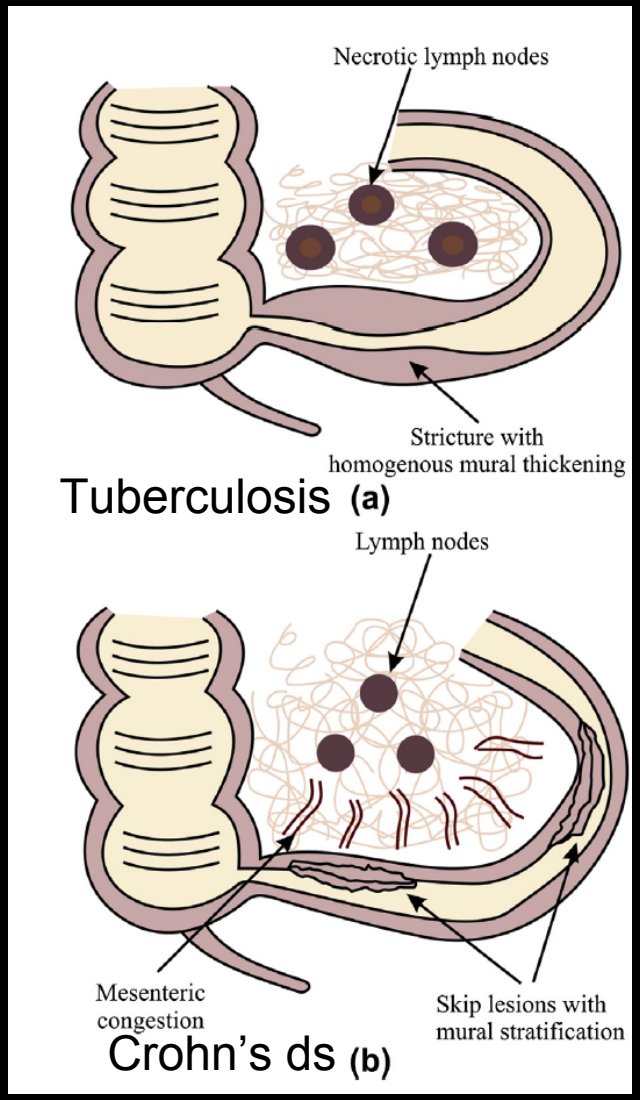
Conventional CT

CT Enteroclysis



CT Enterography

Crohn Disease vs TB



Differentiating features between tuberculosis and Crohn's disease on imaging.

Imaging abnormality	Tuberculosis	Crohn's disease
Strictures	Concentric and smooth	Eccentric and with sacculations
Mural thickening	Without stratification	With stratification
Mesenteric congestion	Absent	Present
Lymph nodes	With necrosis	Mild lymphadenopathy, without necrosis
High-density ascites	Present	Absent
Fibro-fatty proliferation	Absent	Present
Abscesses and fistulae	Absent	Present

Kalra N, et al. Clin Radiol 2014; 69:315-322

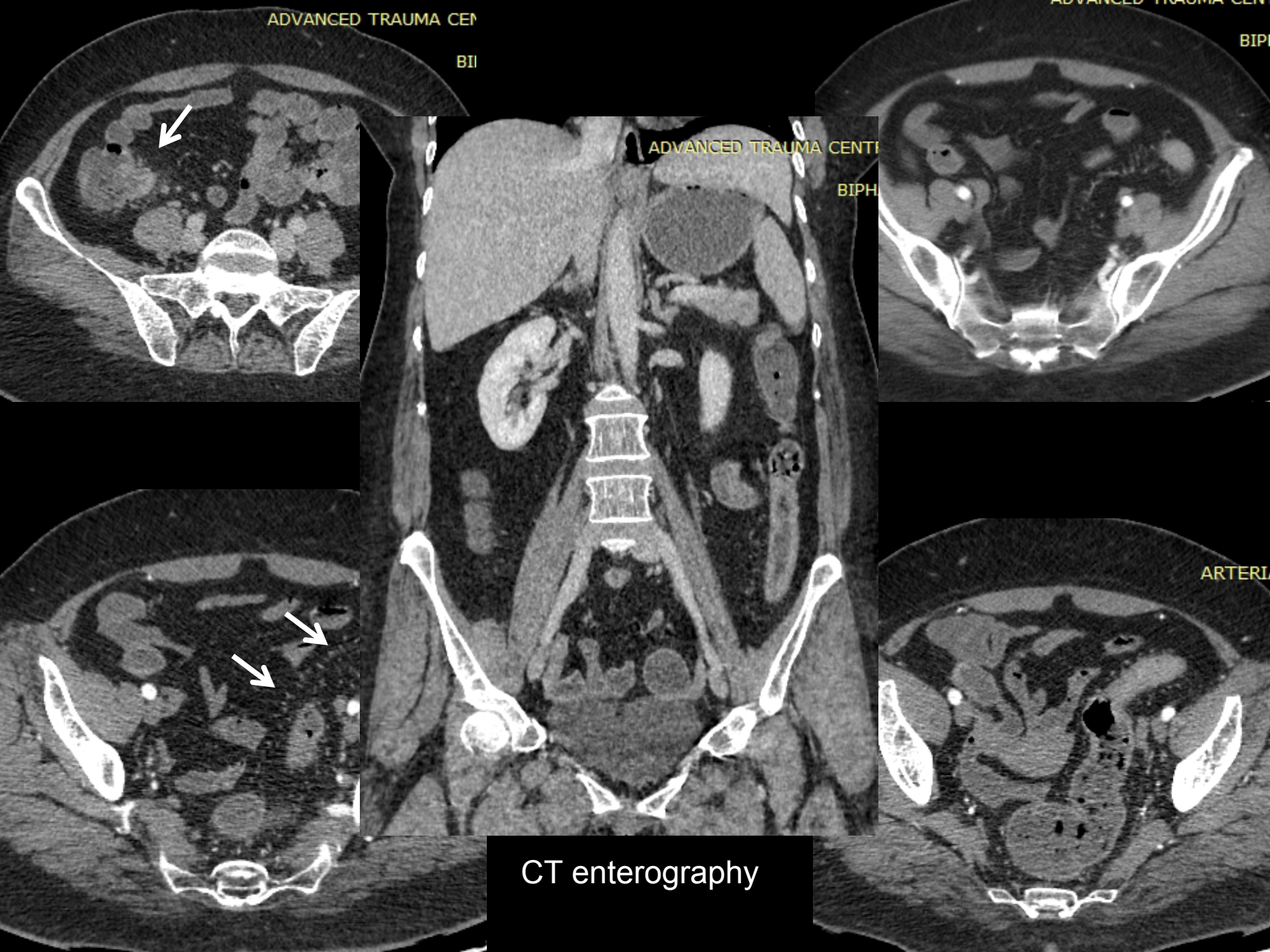
DCBE-Aphthoid ulcers, punctate collections surrounded by radiolucent halos

DCBE-Segmental colitis

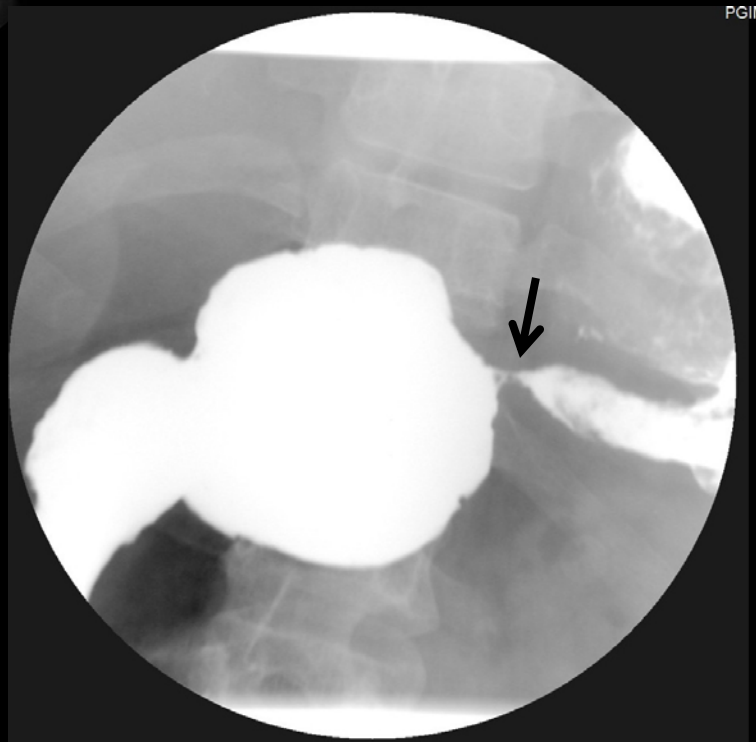
DCBE-Cobblestone appearance

SCBE-Deep ulcers with double tracking

Barium enteroclysis



CT enterography

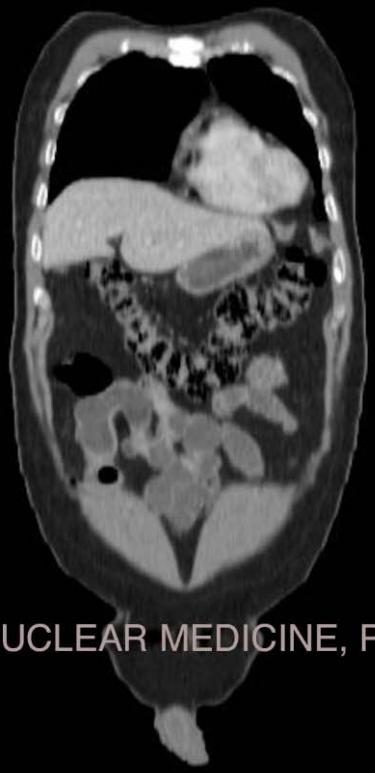


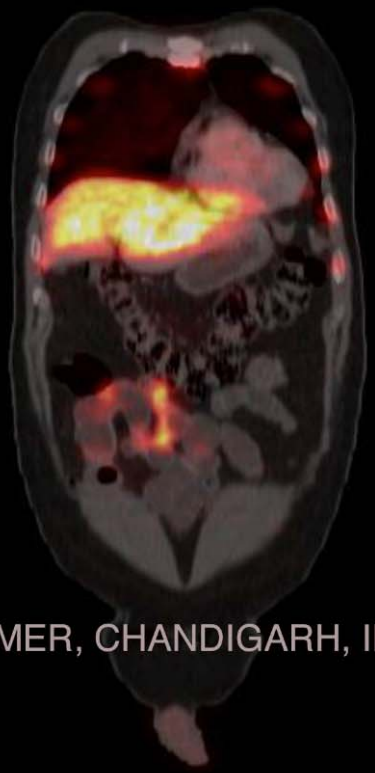
SCBE


HP
HP
Contrast
enhanced MRE

Enterocutaneous fistula

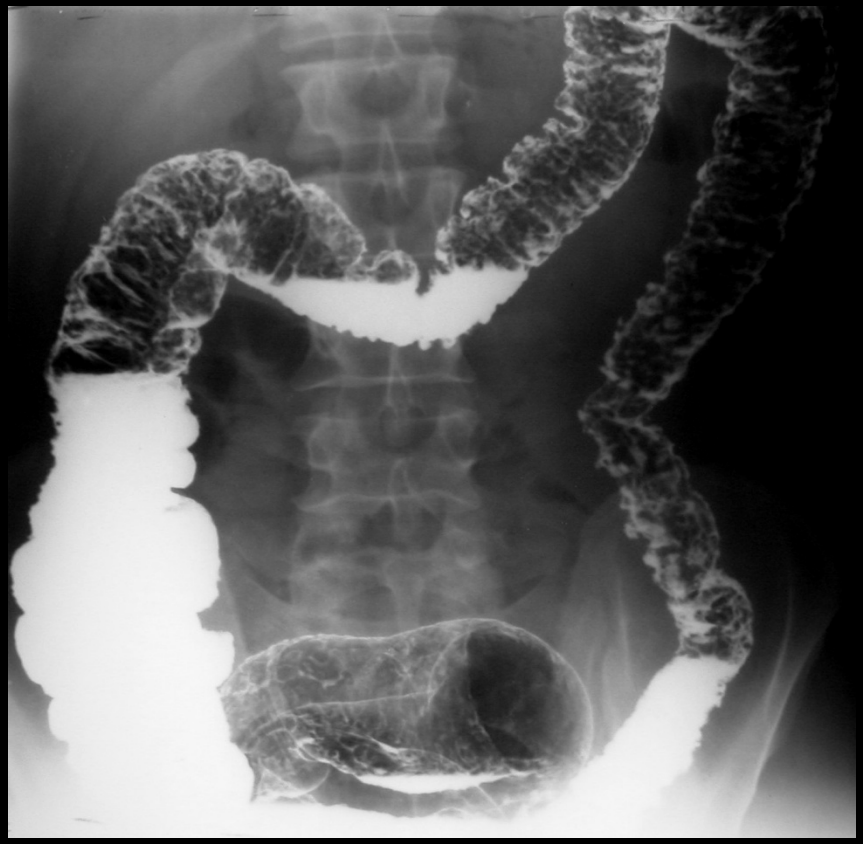
Gut 2006; 733-741



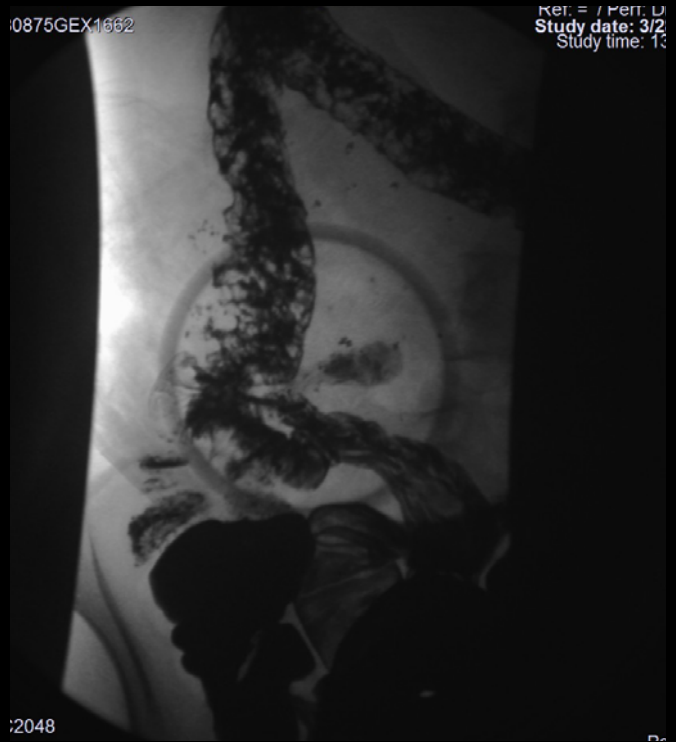


Ulcerative Colitis

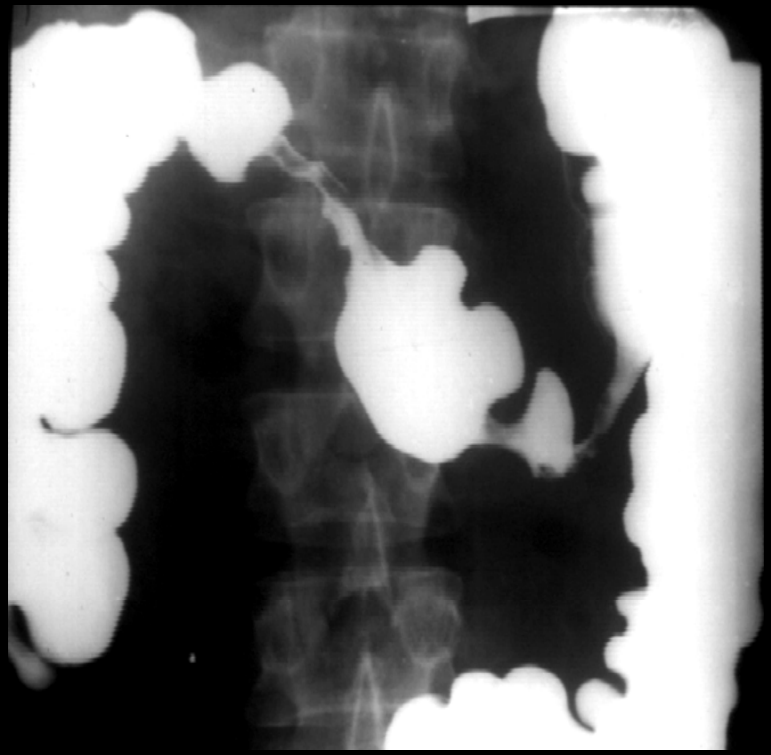
SCBE-Collar button ulcers, deep ulcers that undermine the mucosa



DCBE-Ulcers and pseudopolyps, mounds of inflamed tissue between areas of denuded mucosa



Pseudopolyps



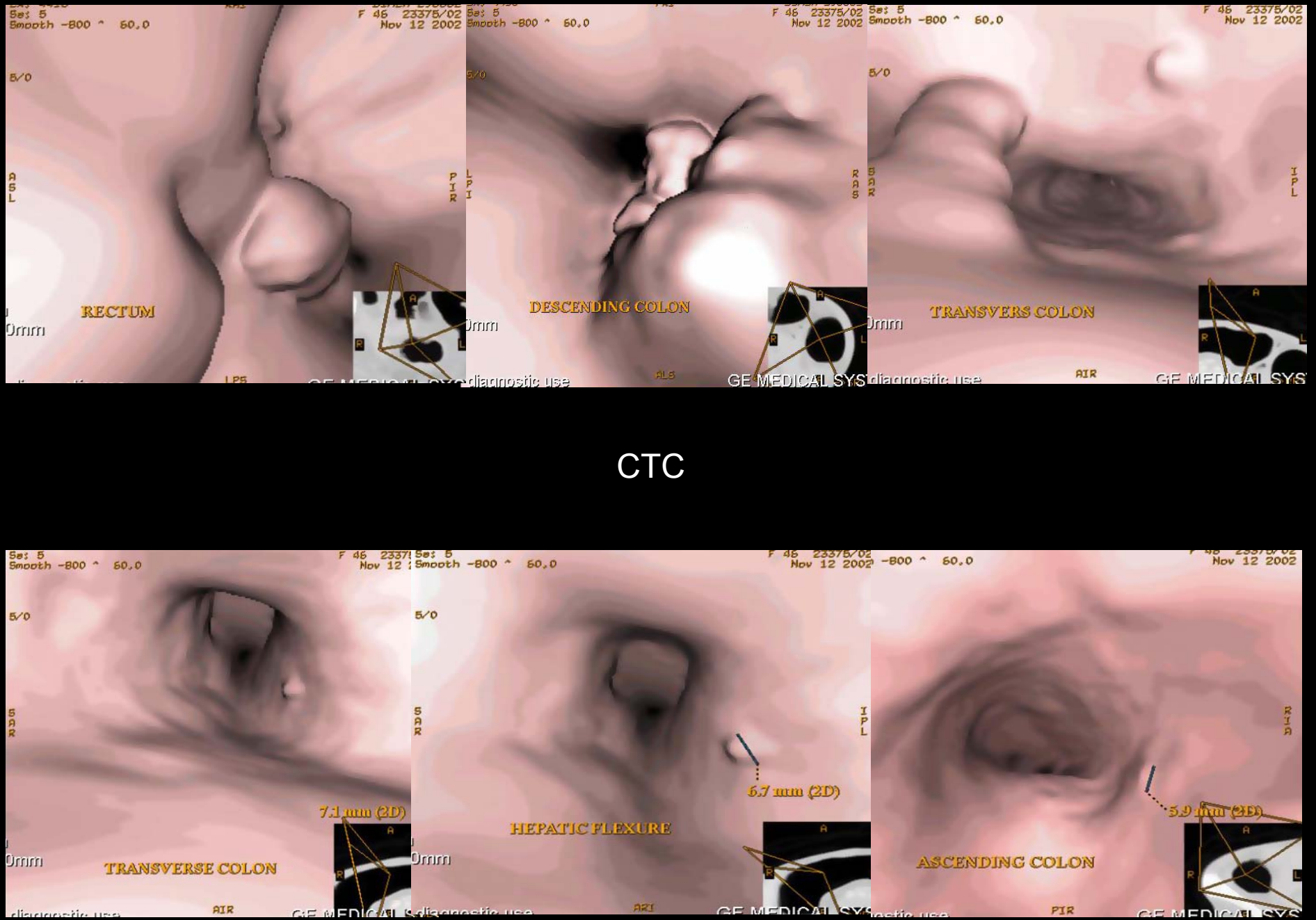
SCBE-Benign stricture

UC and colon cancer

- Risk increases after disease has been present for 8-10 years
- Risk is 5% after 10–20 years of disease and 9% per year thereafter
- Dysplasia (which may be flat and identified only by random biopsies, or it may be macroscopically visible) and a subsequent prophylactic colectomy

SCBE

Conventional CECT


RECTUM
DESCENDING COLON
TRANSVERS COLON
TRANSVERSE COLON
7.1 mm (2D)
HEPATIC FLEXURE
6.7 mm (2D)
ASCENDING COLON
5.9 mm (2D)

CTC

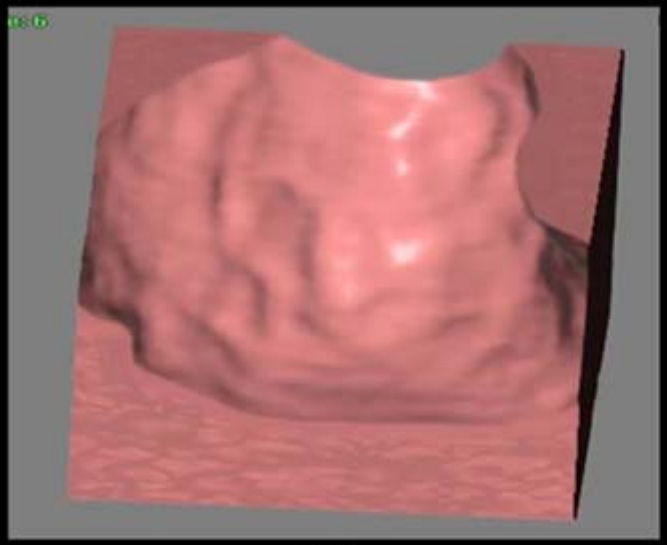
CTC in UC

- 20 patients with proven ulcerative colitis
- Sensitivity and specificity of CT colonoscopy for detecting pseudopolyps were 82.1% and 84.5% respectively and for granular appearance were 81% and 73.8% respectively

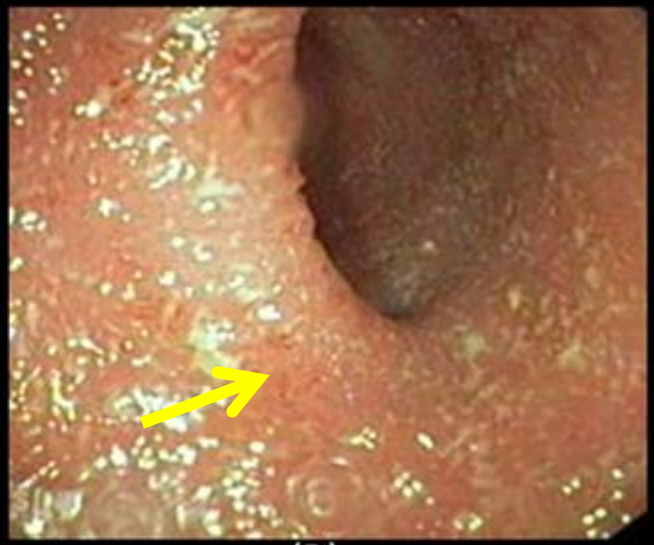
ECR Vienna 2012

(A)

(B)

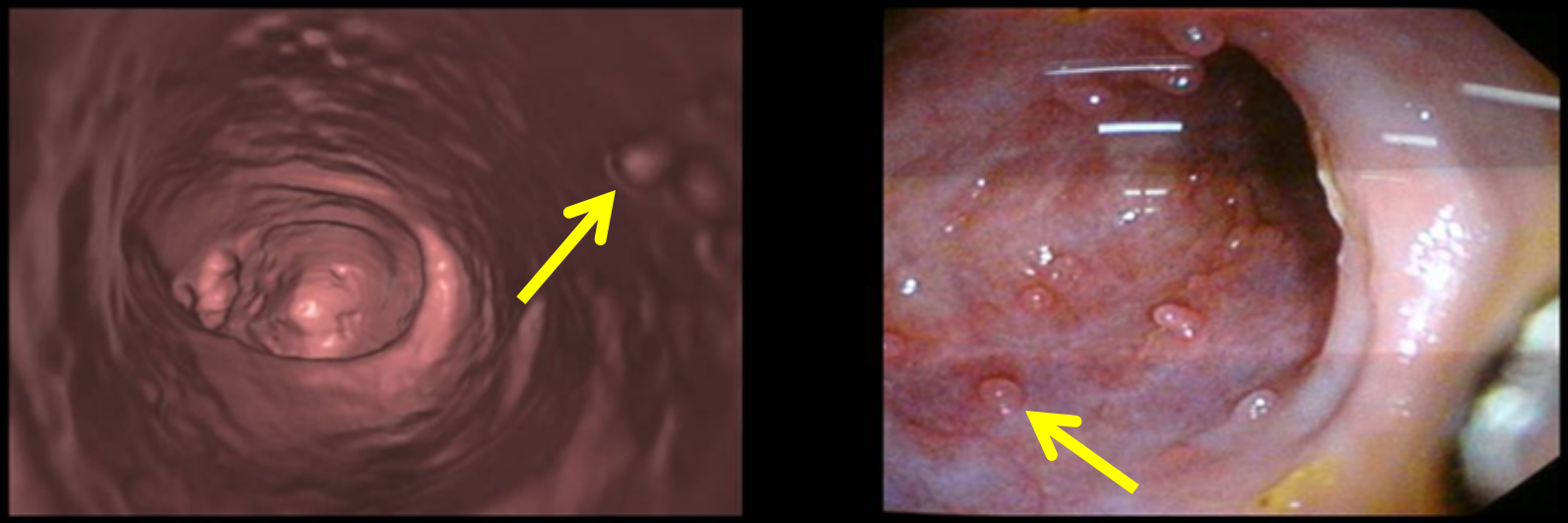


(C)



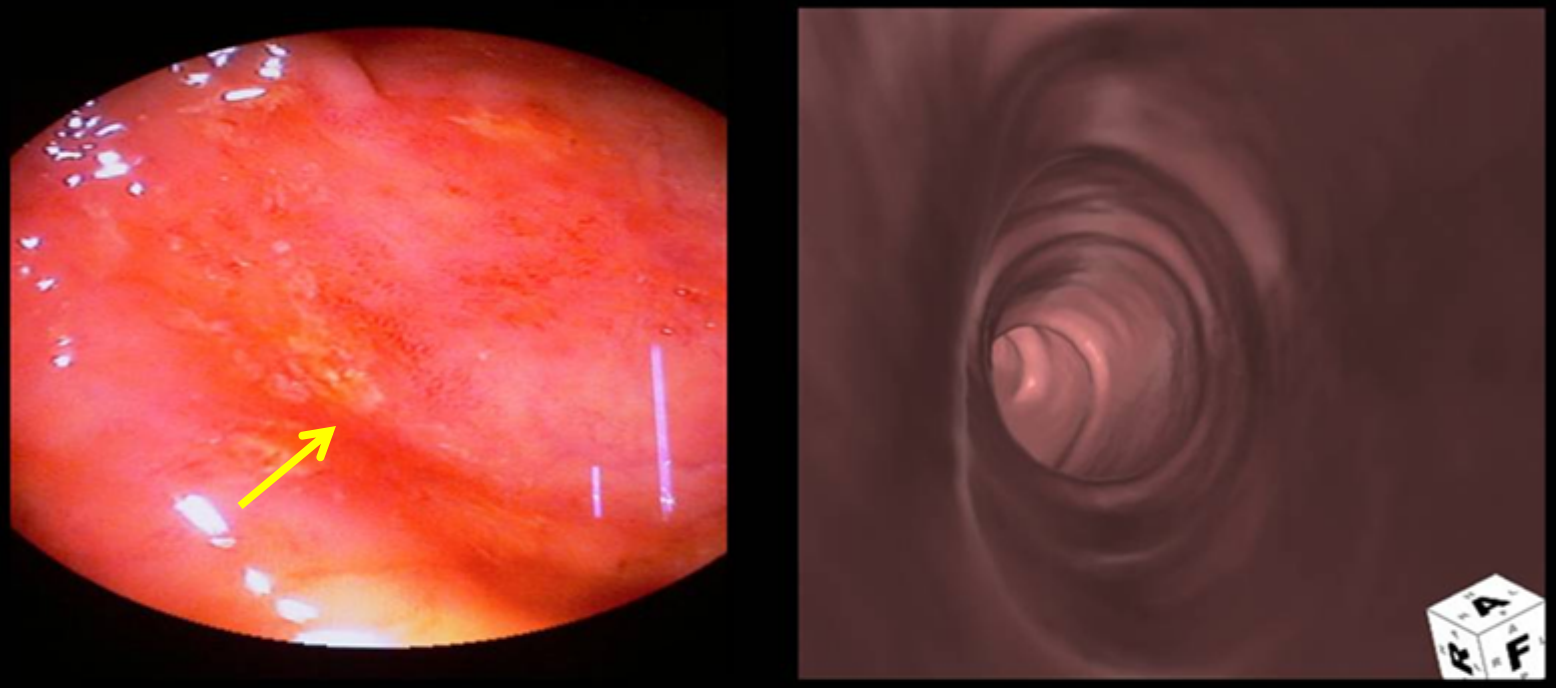
(D)

38-yr-old female with ulcerative colitis for 7 yrs (A) Endoluminal colonographic images, (B) & (C) Cube views and (D) Colonoscopic view of the patient showing granular appearance in the transverse colon.



(A) (B)

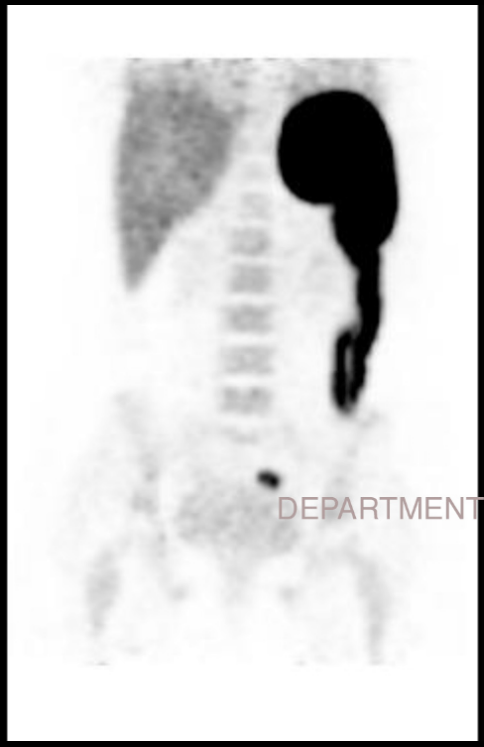
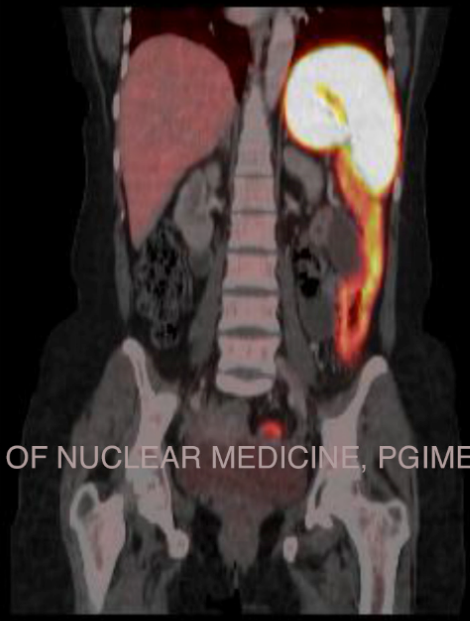
Typical findings of ulcerative colitis as seen in a 40 year old male with history of ulcerative colitis from 10 yrs: Granular appearance with pseudopolyps in descending colon as seen on (A) colonographic endoluminal images and (B) colonoscopic images.



(A) (B)

(A) Colonoscopy revealed superficial ulceration, erosions and loss of vascular pattern in the descending colon in a 35-yr-old male with 7 yr h/o ulcerative colitis. (B) Endoluminal colonographic images on the other hand show a normal appearance of same part of descending colon.

31-yr-old female with ulcerative colitis for 4 yrs. (A) Axial, (B) & (C) coronal MPR images showing typical extraluminal findings of ulcerative colitis: loss of haustral folds, wall thickening, increased pericolonic vascularity and pericolonoic lymph nodes and incidental extracolonic finding of hepatomegaly with fatty changes.


Meta-analysis

Based on 33 studies

	MRI	Scintigraphy	CT
Per-patient basis			
Sensitivity	93%	87.8%	84.3%
Specificity	92.8%	84.5%	95.1%
Per-bowel segment basis			
Sensitivity	70.4%	77.3%	67.4%
Specificity	94%	90.3%	90.2%

Horsthuis et al. Radiology 2008; 247: 64-79

Clinical Condition: **Crohn Disease**

Variant 1: **Adult. Initial presentation. Suspected Crohn disease.**

Radiologic Procedure	Rating	Comments	RRL*
CT enterography	9		☢☢☢☢
MR enterography	8	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray small-bowel follow-through	7		☢☢☢
CT abdomen and pelvis with contrast (routine)	6		☢☢☢☢
X-ray contrast enema	6		☢☢☢
X-ray abdomen	5	May be useful to exclude free air if perforated hollow viscus is suspected.	☢☢
US abdomen and pelvis	5		O
US pelvis endorectal	3		O
Tc-99m HMPAO leucoscintigraphy	3		☢☢☢

Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate** ***Relative Radiation Level**

2013 Document

Variant 2: **Child or young adult. Initial presentation. Suspected Crohn disease.**

Radiologic Procedure	Rating	Comments	RRL*
CT enterography	9		☢ ☢ ☢ ☢
MR enterography	9	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT abdomen and pelvis with contrast (routine)	7		☢ ☢ ☢ ☢
X-ray small-bowel follow-through	7	The RRL for the adult procedure is ☢ ☢ ☢ .	☢ ☢ ☢ ☢
US abdomen and pelvis	6		O
X-ray contrast enema	5	The RRL for the adult procedure is ☢ ☢ ☢ .	☢ ☢ ☢ ☢
X-ray abdomen	5	May be useful to exclude free air if perforated hollow viscus is suspected.	☢ ☢
Tc-99m HMPAO leucoscintigraphy	3		☢ ☢ ☢
US pelvis endorectal	2		O

Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**

***Relative Radiation Level**

Variant 3: **Adult with known Crohn disease; acute exacerbation such as fever or increasing abdominal pain or leukocytosis.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast (routine)	9	Routine CT may be acceptable to detect abscess or bowel obstruction if patient is unable to drink the volume of contrast required for enterography.	☢☢☢☢
CT enterography	9		☢☢☢☢
MR enterography	8	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray abdomen	5	May be useful to exclude free air if perforated hollow viscus is suspected.	☢☢
US abdomen and pelvis	5		O
X-ray contrast enema	4		☢☢☢
X-ray small-bowel follow-through	4		☢☢☢
US pelvis endorectal	4		O
Tc-99m HMPAO leucoscintigraphy	4		☢☢☢

Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**

***Relative Radiation Level**

Variant 4: **Child or young adult with known Crohn disease; acute exacerbation such as fever or increasing abdominal pain or leukocytosis.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast (routine)	9	Routine CT may be acceptable to detect abscess or bowel obstruction if patient is unable to drink the volume of contrast required for enterography.	☢ ☢ ☢ ☢
CT enterography	9	Consider dose reduction techniques.	☢ ☢ ☢ ☢
MR enterography	9	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
US abdomen and pelvis	6		O
X-ray abdomen	5	May be useful to exclude free air if perforated hollow viscus is suspected.	☢ ☢
X-ray small-bowel follow-through	5	The RRL for the adult procedure is ☢ ☢ ☢ .	☢ ☢ ☢ ☢
X-ray contrast enema	4	The RRL for the adult procedure is ☢ ☢ ☢ .	☢ ☢ ☢ ☢
Tc-99m HMPAO leucoscintigraphy	4		☢ ☢ ☢
US pelvis endorectal	2		O

Clinical Condition: **Crohn Disease**

Variant 5: **Adult with known Crohn disease; stable, mild symptoms and/or surveillance.**

Radiologic Procedure	Rating	Comments	RRL*
CT enterography	9	Consider dose reduction techniques.	☢ ☢ ☢ ☢
MR enterography	8	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray small-bowel follow-through	7		☢ ☢ ☢
CT abdomen and pelvis with contrast (routine)	6		☢ ☢ ☢ ☢
X-ray abdomen	5	May be useful to exclude free air if perforated hollow viscus is suspected.	☢ ☢
X-ray contrast enema	4		☢ ☢ ☢
US abdomen and pelvis	4		O
US pelvis endorectal	2		O
Tc-99m HMPAO leucoscintigraphy	2		☢ ☢ ☢

Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate** ***Relative Radiation Level**

Variant 6: **Child or young adult with known Crohn disease; stable, mild symptoms and/or surveillance.**

Radiologic Procedure	Rating	Comments	RRL*
MR enterography	9	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
US abdomen and pelvis	6		O
CT enterography	6	Consider dose reduction techniques. The higher spatial resolution obtained with CT is usually not required for surveillance of areas of known Crohn disease.	☢ ☢ ☢ ☢
X-ray small-bowel follow-through	5	The RRL for the adult procedure is ☢ ☢ ☢ .	☢ ☢ ☢ ☢
CT abdomen and pelvis with contrast (routine)	5		☢ ☢ ☢ ☢
X-ray abdomen	5	May be useful to exclude free air if perforated hollow viscus is suspected.	☢ ☢
X-ray contrast enema	4	The RRL for the adult procedure is ☢ ☢ ☢ .	☢ ☢ ☢ ☢
Tc-99m HMPAO leucoscintigraphy	2		☢ ☢ ☢
US pelvis endorectal	2		O

Variant 6: High-risk individual: ulcerative colitis or Crohn colitis.

Radiologic Procedure	Rating	Comments	RRL*
CT colonography	3	Colonoscopy is the preferred procedure for its ability to obtain biopsies to look for dysplasia.	☢ ☢ ☢
X-ray barium enema double-contrast	2	Colonoscopy is the preferred procedure for its ability to obtain biopsies to look for dysplasia.	☢ ☢ ☢
MR colonography	2	Colonoscopy is the preferred procedure for its ability to obtain biopsies to look for dysplasia.	○
X-ray barium enema single-contrast	1	Colonoscopy is the preferred procedure for its ability to obtain biopsies to look for dysplasia.	☢ ☢ ☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Conclusion

- CTE and MRE are the preferred imaging modalities for the small bowel for the initial diagnosis and surveillance of patients
- CTC is not the preferred imaging modalities for the large bowel for the initial diagnosis and surveillance of patients
- Barium studies may be done for demonstrating anatomy of abnormalities

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